



# Accelerator & NuMI Upgrades Update

Paul Derwent

22 January 2013

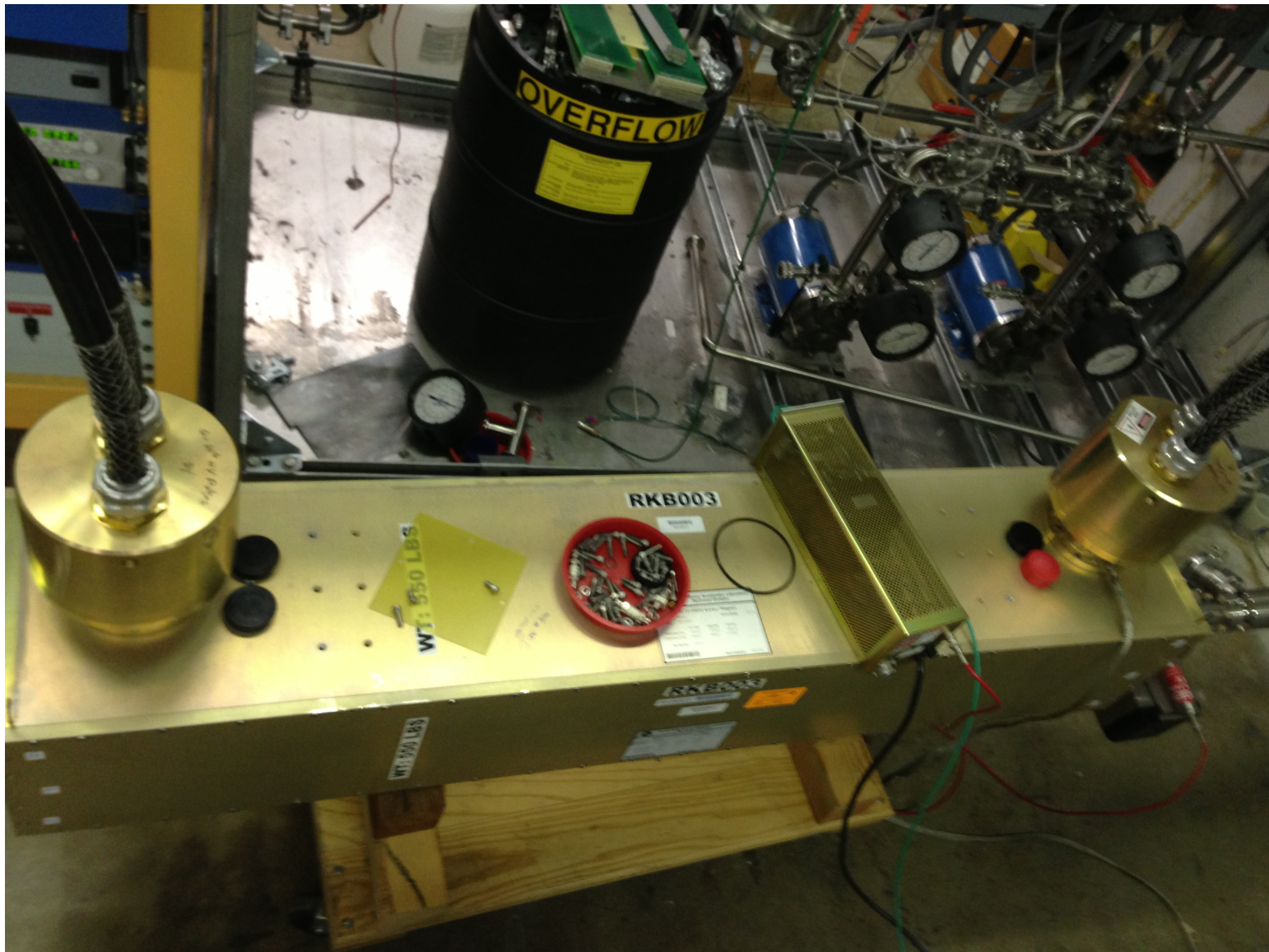


# Remaining Critical Path Hardware

- Remaining kickers are in fabrication
  - Long full turn RKB magnets in progress (2 through HV testing, 3 through LV testing)
- RF cavities:
  - First cavity through power tests
  - 2<sup>nd</sup> cavity (Phoenix) had major vacuum welds in June
    - Vacuum ports complete in December
    - Finishing on operations funds (SPS)
  - 3<sup>rd</sup> cavity (Rising Son) moved ahead of Phoenix in queue
    - Into test cave for power tests
- Beam Pipe & Vacuum components:
  - Coming in slowly
  - Injection line installation moving along
    - MI8 first, then RR8 line
  - Remaining components all on order



# RKB in test cage







# Preparing for RR30 installation

## RR-30 straight:

Staging stands and other hardware in the tunnel in preparation for installation



**RR-30 straight:** At MI-60  
beam pipe welding, leak checking, &  
alignment

-> minimize radiation exposure

Girders installed on the stands





# RF Cavity status



## Recycler RF #1 Status

- RF testing complete
- RGA scans and Leak checking is complete
- Water Hoop needs to be added to input interface coupler
- Stretched wire mode measurements coming

**2<sup>nd</sup> Cavity (Rising Son)**  
ready to go into test cave, mounted on installation cradle

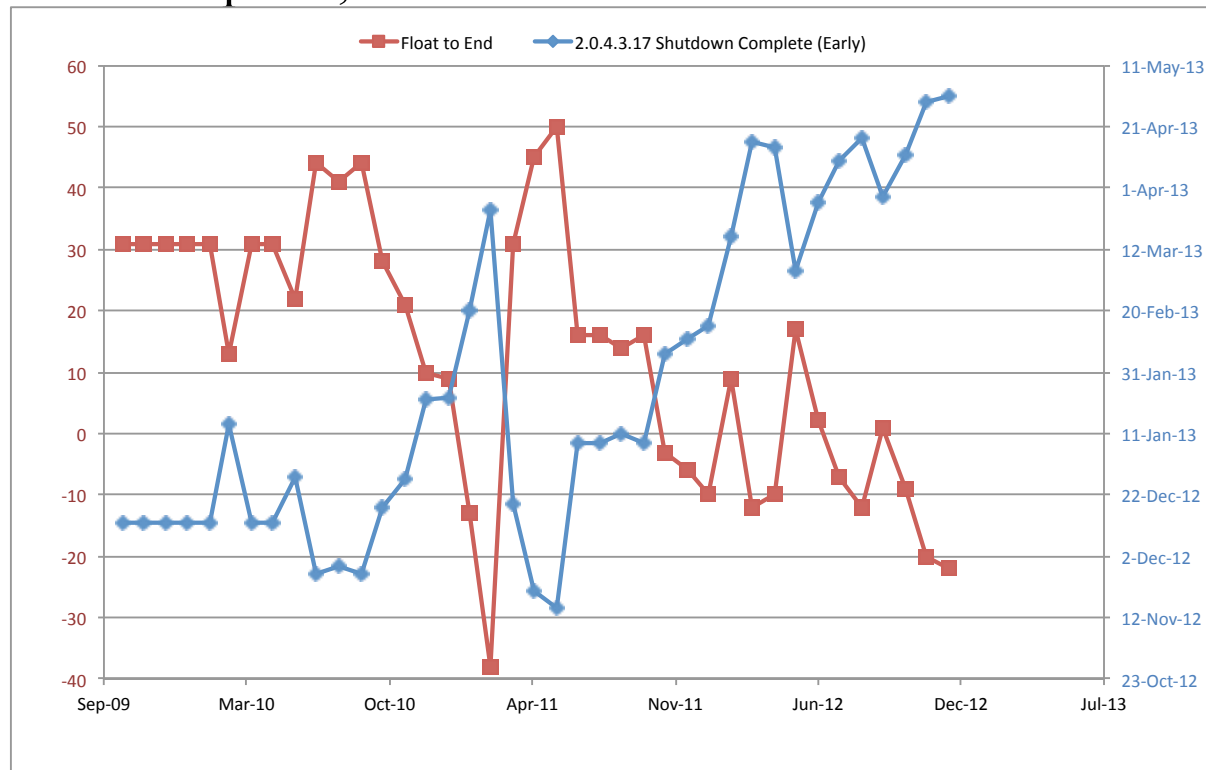
## Recycler RF #2





# Shutdown float

- OpenPlan end of shutdown: May 1st
  - Kicker Power Supply work in Service Building -> underway now
  - RR30 installation -> starting in February
  - RF Cavity -> starting in February
  - -22 days of float to April 1, 2013





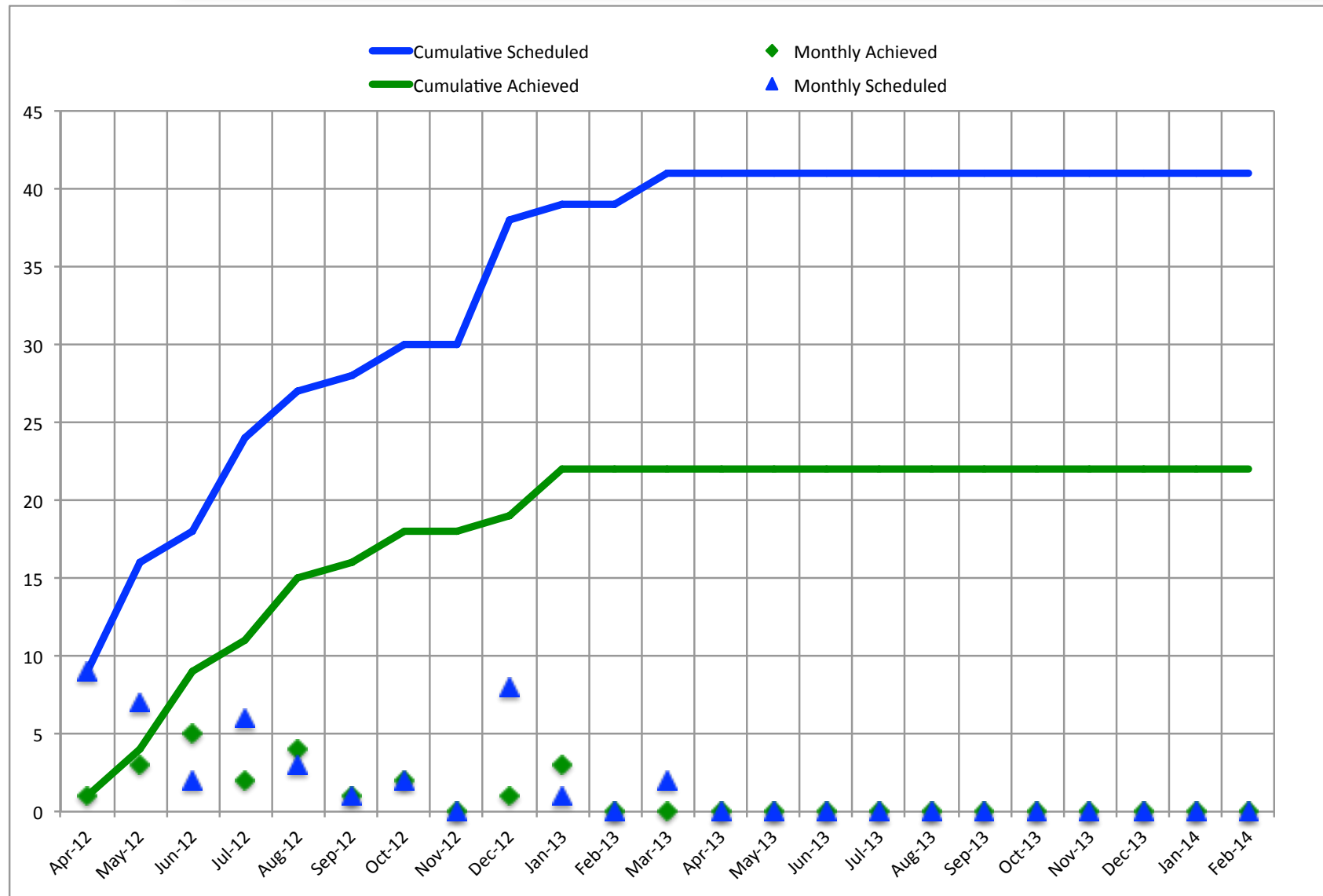
# Target Hall installation

- Target & Horn 1 ready to go!
  - Horn 1 Installation (off project)
    - 11 – 22 February
  - Horn 1 power testing, beam pipe window installation, dehumidification work in March
  - Target installation
    - 1 – 12 April
  - Target hall buttoned up and ready for beam by 26 April

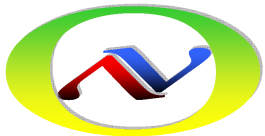




# Remaining milestones

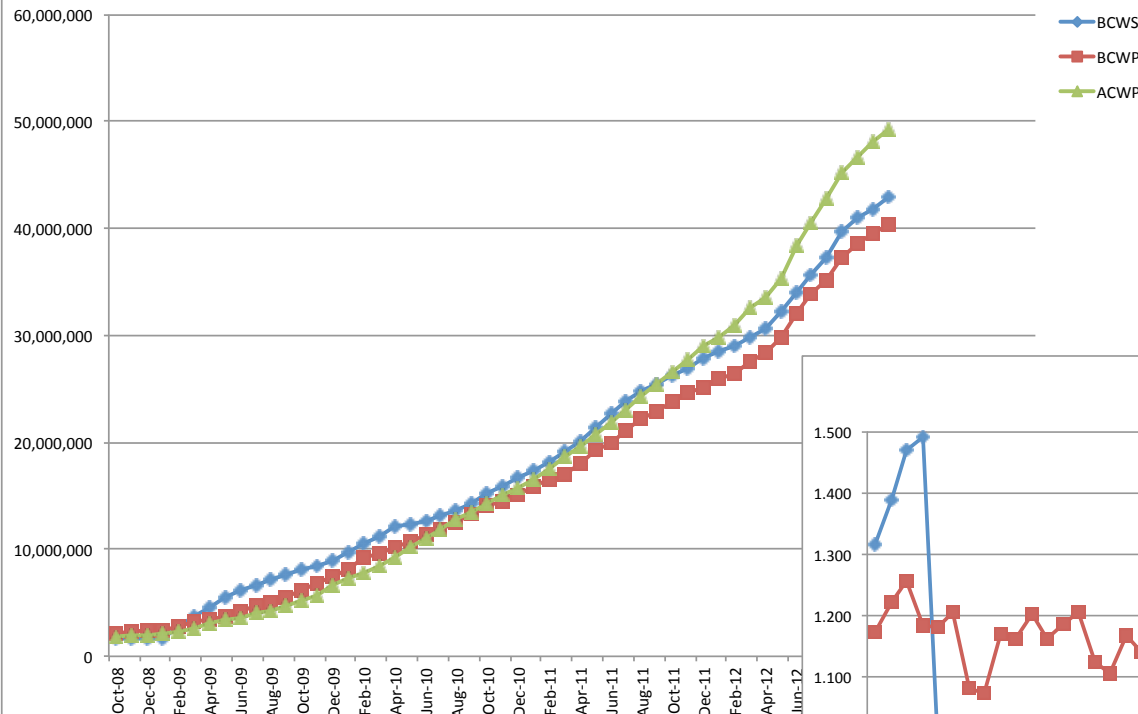




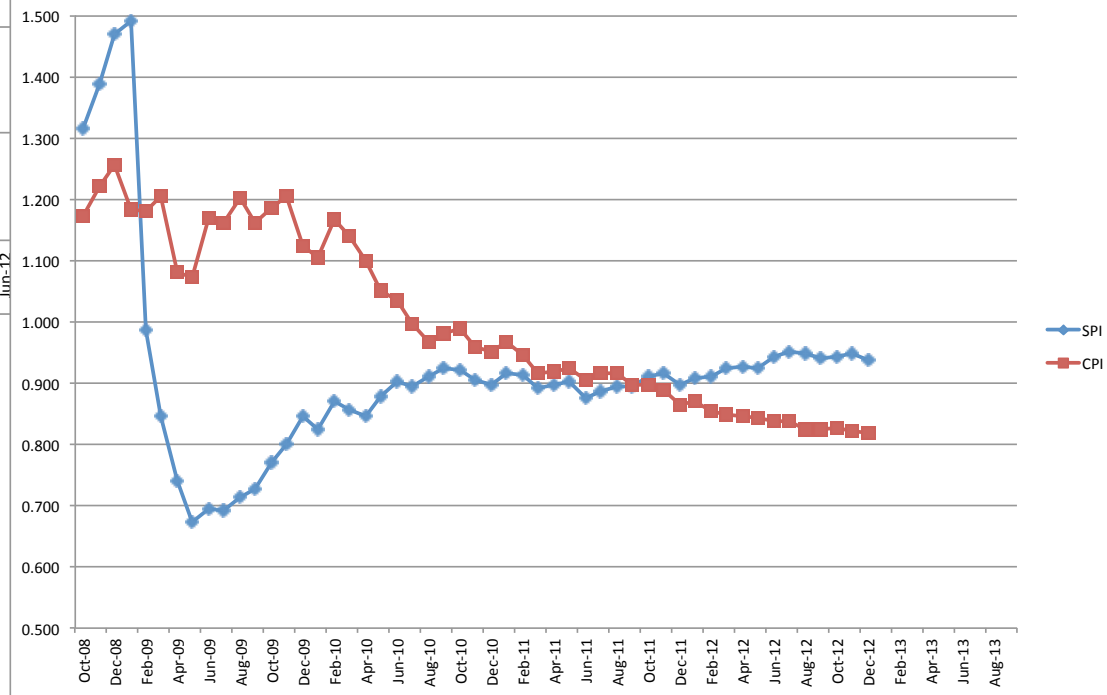


# EVMS Performance

Cumulative Performance



Performance Indices (Cumulative)





# Estimates to Complete

- November 14: started polling the L3/L4s in ANU on remaining budget vs remaining work
  - Showed them the budget and asked if it was enough
  - Results went into the McCluskey ETC assessment in December
- January 3: started another round with L3/L4s
  - Asked a different question: how much effort is required to complete the work?
  - Broke it down into 27 pieces and went to speak with responsible parties
  - Labor in major categories (techs, engineers, drafting, machining, welding, electricians, riggers)
  - Making a comparison between budget and estimate
  - A bottoms up estimate, with top down multipliers from me (in 10 of the 27 sections, 50-100%)

NB: week before  
Lehman review!



# Budget – Estimate Result

|                                    |  | Tech Days | Welder Days | Electrician Days<br>(or maybe<br>pipefitters!) | Rigger<br>Days | Engineering<br>Days |         |
|------------------------------------|--|-----------|-------------|--|----------------|---------------------|---------|
| total                              |  | 264       | (178)       | 7  | (185)          | 184                 |         |
| II Beam Pipe & Vacuum Installation |  | (18)      | (15)        | 0  | 0              | 0                   |         |
| MI 60 Staging Crew                 |  | 29        | 0           | 0  | 0              | 0                   |         |
| MI 60 Girder Work                  |  | (80)      | (15)        | 0  | 0              | 0                   |         |
| RR 30 Straight Installation        |  | (17)      | 0           | 0  | (203)          | 5                   |         |
| EL Installation                    |  | 45        | 0           | 0  | (75)           | 5                   |         |
| Multiwire/DCCT/Toroid fabrication  |  | (132)     | 12          | 0  | 0              | (36)                |         |
| DCCT Installation                  |  | 34        | 0           | 0  | 0              | 3                   |         |
| MI 614 Reconstruction              |  | (33)      | (2)         | 0  | 0              | 0                   |         |
| RR RF Installation                 |  | 137       | (3)         | 0  | 39             | 15                  |         |
| Damper Installation                |  | 32        | (2)         | 12   | 32             | 3                   |         |
| BPM Hardware Installation          |  | (90)      | 0           | 0  | 0              | (12)                |         |
| Vacuum Hardware & Prep             |  | (187)     | (214)       | 0  | 0              | 3                   |         |
| RR RF cavity 1 Retrofit            |  | (27)      | 38          | 0  | 0              | 8                   |         |
| RR RF mid & hi level               |  | (100)     | 0           | 0  | 0              | (5)                 |         |
| RR RF low level                    |  | 4         | 0           | 0  | 0              | (14)                |         |
| RR Water                           |  | 48        | (2)         | 15   | 0              | 25                  |         |
| NuMI Water                         |  | 50        | 0           | 50   | 0              | 4                   |         |
| Recycler Shims                     |  | 66        | 0           | 0  | 0              | 0                   |         |
| Cable Pulls                        |  | 0         | 0           | (70)   | 0              | 0                   |         |
| RKB Fabrication                    |  | 94        | 20          | 0  | 0              | 72                  |         |
| Kicker Power Supplies & Testing    |  | 297       | (8)         | 0  | 0              | 96                  |         |
| Installation Planning              |  | (35)      | 12          | 0  | 0              | (75)                |         |
| Target & Horn 1 Installation       |  | 111       | 0           | 0  | 0              | 18                  |         |
| Target Hall Infrastructure         |  | 26        | 0           | 0  | 23             | 13                  |         |
| Timing & Controls                  |  | (23)      | 0           | 0  | 0              | (2)                 |         |
| RBEX and Ramped Supplies           |  | 58        | 0           | 0  | 0              | 55                  |         |
| Ramped Correctors                  |  | (26)      | 0           | 0  | 0              | 3                   |         |
|                                    |  |           |             |  |                |                     |         |
| Dollars?                           |  | \$195,287 | (\$192,939) | \$6,619  | (\$225,674)    | \$218,478           | \$1,771 |
| value of a single day              |  | \$740     | \$1,035     | \$920  | \$1,322        | \$1,185             |         |

Balance to  
\$1,771!!!





# On the other hand

- (\$415k) in November
- (\$434k) in December
- Labor CPI (Sep-Dec) : 0.89
  - Have finished with Pipefitters (-\$1.1M) and almost finished with electricians (-\$550k)
- Money tied up in Performance Measurement Techniques?
  - Type E: 50-50 (50% BCWP when start, 50% BCWP when finish)
  - Type F: 0-100 (100% BCWP when finish)
  - \$231k of progress reported but not in BCWP
  - Continue through April
    - \$1.26M in unstarted tasks of type E,F
    - \$900k in unstarted tasks of type C
- Money tied up in Pump Vault 9 Construction
  - Went off project in November – from the budget perspective but not the actual cost perspective
  - Through December PO 607695: \$41,550 direct costs
    - \$51,060.08 fully loaded costs in ACWP with no BCWP
  - PO and charges moved to AD code on January 14
    - Positive variance from this next month



# Summary

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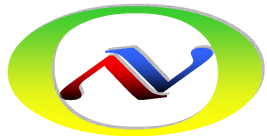
- Shutdown work progressing
  - Start the RR30 work in February
  - Start Horn 1 and Target installation in February
- No longer on schedule for 1 April 2013 completion
  - End of April is current estimate
- Doing regular ETC
  - January estimate: minimal CV in next 4 months
  - looking for ways to recover costs



Additional information if necessary to discussion

Aka Backups!

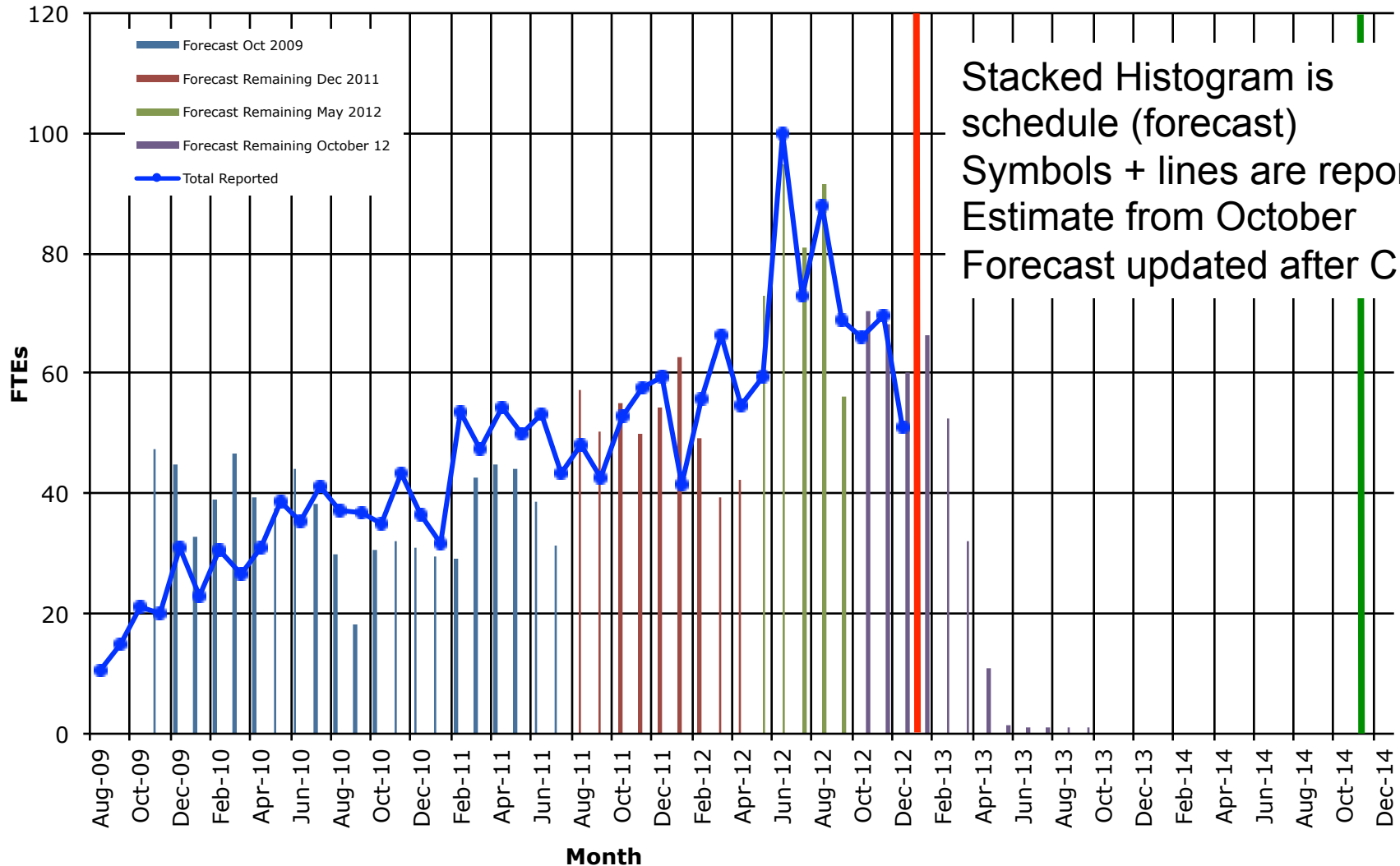




## ANU Resource Requirements

Time Now

CD-4



Stacked Histogram is  
schedule (forecast)  
Symbols + lines are reporting  
Estimate from October  
Forecast updated after CR573

FTE := 147.3 hours/month



# ANU Work Force

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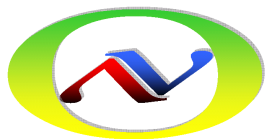
- Changes in staffing over last several years
  - Shuffling people around
  - Bringing new people in
  - Leads to Inefficiencies
- Concrete Example: Recycler Low Level RF Development
  - Summer 2011, expert (10+ years experience with MI and RR LLRF) left the laboratory as found another job, 'did not like the direction'
  - Fall 2011, replaced with two new members coming from other areas (Pbar and Tev) but neither had direct LLRF experience
  - Took 2 people 2x as long as the estimate
    - 4x the cost to the project (\$240k additional expense)



# Budget for remaining tasks

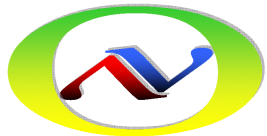
| through December Status                              | Tech Days   | Welder Days | Electrician Days | Rigger Days | Engineering Days |             | M&S (loaded \$) | M&S (unloaded \$) |
|--|-------------|-------------|------------------|-------------|------------------|-------------|-----------------|-------------------|
|  |             |             |                  |             |                  |             |                 | 1.16              |
| total  | 2751.5025   | 88.65       | 96.75625         | 310.5       | 740.87625        |             | \$348,591       | \$300,509.39      |
| II Beam Pipe & Vacuum Installation                   | 100         |             |                  |             |                  |             | \$2,923         | \$2,519.61        |
| MI 60 Staging Crew                                   | 269.0625    |             |                  |             | 30               |             |                 |                   |
| MI 60 Girder Work                                    | 0           |             |                  |             |                  |             |                 |                   |
| RR 30 Straight Installation                          | 198.75      |             |                  | 66.75       | 5                |             | \$11,833        | \$10,200.86       |
| EL Installation                                      | 150         |             |                  | 60          | 5                |             | \$17,811        | \$15,354.31       |
| Multiwire/DCCT/Toroid fabrication                    | 4.725       | 15          |                  |             | 1.5              |             | \$0             |                   |
| DCCT Installation                                    | 72          |             |                  |             | 3.2              |             | \$0             |                   |
| MI 614 Reconstruction                                | 0           |             |                  |             |                  |             | \$0             |                   |
| RR RF Installation                                   | 305         |             |                  | 129         | 15               |             | \$34,401        | \$29,656.34       |
| Damper Installation                                  | 92.25       |             | 12               | 32.25       | 3                |             | \$52,061        | \$44,880.17       |
| BPM Hardware Installation                            | 42          |             |                  |             |                  |             | \$0             |                   |
| Vacuum Hardware & Prep                               | 3.24        |             |                  |             | 3.24             |             | \$41,834        | \$36,064.05       |
| RR RF cavity 1 Retrofit (includes testing in budget) | 37.755      | 40.95       |                  |             | 38.27375         |             | \$3,056         | \$2,634.24        |
| RR RF mid & hi level                                 | 0           |             |                  |             |                  |             | \$0             |                   |
| RR RF low level                                      | 4.35        |             |                  |             | 41.1             |             | \$0             |                   |
| RR Water   | 75.83125    |             | 15.01875         |             | 34.7625          |             | \$5,614         | \$4,839.50        |
| NuMI Water   | 90.15625    |             | 49.7375          |             | 18.75            |             | \$43,219        | \$37,257.97       |
| Recycler Shims                                       | 146.0625    |             |                  |             |                  |             | \$0             |                   |
| Cable Pulls  |             |             | 20               |             |                  |             | \$0             |                   |
| RKB Fabrication                                      | 94.42       | 20.28       |                  |             | 71.88625         |             | \$19,211        | \$16,561.59       |
| Kicker Power Supplies & Testing                      | 484.26875   |             |                  |             | 245.58125        |             | \$40,362        | \$34,794.83       |
| Installation Planning                                | 55.4        | 12.42       |                  |             | 30.47            |             | \$0             |                   |
| Target & Horn 1 Installation                         | 210.95625   |             |                  |             | 42.28125         |             | \$35,521        | \$30,621.85       |
| Target Hall Infrastructure                           | 106.05      |             |                  | 22.5        | 15.9             |             | \$5,673         | \$4,890.52        |
| Timing & Controls                                    | 26.725      |             |                  |             | 28.48125         |             | \$16,935        | \$14,599.40       |
| RBEX and Ramped Supplies                             | 158         |             |                  |             | 104.95           |             | \$8,649         | \$7,455.69        |
| Ramped Correctors                                    | 24.5        |             |                  |             | 2.5              |             | \$9,487         | \$8,178.45        |
|  |             |             |                  |             |                  |             |                 |                   |
| Dollars?   | \$2,035,328 | \$96,171    | \$94,792         | \$379,792   | \$877,907        | \$3,483,990 |                 |                   |
| value of a single day                                | \$740       | \$1,085     | \$980            | \$1,223     | \$1,185          |             |                 |                   |





# Estimates for remaining tasks

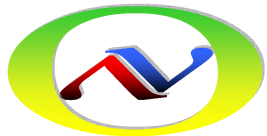
|                                    | Tech Days   | Welder Days | Electrician Days | Rigger Days | Engineering Days |  | scale factor |
|------------------------------------|-------------|-------------|------------------|-------------|------------------|--|--------------|
| total                              | 2487.5      | 266.5       | 90               | 495         | 556.5            |  |              |
| MI Beam Pipe & Vacuum Installation | 118         | 15          |                  |             |                  |  |              |
| MI 60 Staging Crew                 | 240         |             |                  |             | 30               |  |              |
| MI 60 Girder Work                  | 80          | 15          |                  |             |                  |  |              |
| RR 30 Straight Installation        | 216         |             |                  | 270         |                  | 50% more   | 1.5          |
| EL Installation                    | 105         |             |                  | 135         |                  | 50% more   | 1.5          |
| Multiwire/DCCT/Toroid fabrication  | 137         | 3           |                  |             | 37.5             | using Sep-Nov and extrapolating for 4 months Jan-April     |              |
| DCCT Installation                  | 38          |             |                  |             |                  |  |              |
| MI 614 Reconstruction              | 33          | 2           |                  |             |                  |  |              |
| RR RF Installation                 | 168         | 3           |                  | 90          |                  | 50% more   | 1.5          |
| Damper Installation                | 60          | 2           |                  |             |                  |  |              |
| BPM Hardware Installation          | 132         |             |                  |             | 12               | double   | 2            |
| Vacuum Hardware & Prep             | 190         | 214         |                  |             |                  | double   | 2            |
| RR RF cavity 1 Retrofit            | 65          | 3           |                  |             | 30               |  |              |
| RR RF mid & hi level               | 100         |             |                  |             | 5                |  |              |
| RR RF low level                    |             |             |                  |             | 55               |  |              |
| RR Water                           | 28          | 2           |                  |             | 10               |  |              |
| NuMI Water                         | 40          |             |                  |             | 15               |  |              |
| Recycler Shims                     | 80          |             |                  |             |                  |  |              |
| Cable Pulls                        |             |             | 90               |             |                  |  |              |
| RKB Fabrication                    | 0           |             |                  |             | 0                |  |              |
| Kicker Power Supplies & Testing    | 187.5       | 7.5         |                  |             | 150              | 50% more   | 1.5          |
| Installation Planning              | 90          |             |                  |             | 105              | 50% more drafting (as tech) and engineering                | 1.5          |
| Target & Horn 1 Installation       | 100         |             |                  |             | 24               | guess hadron monitor at same level as target installation? |              |
| Target Hall Infrastructure         | 80          |             |                  |             | 3                | double this  | 2            |
| Timing & Controls                  | 50          |             |                  |             | 30               | double this  | 2            |
| RBEX and Ramped Supplies           | 100         |             |                  |             | 50               |  |              |
| Ramped Correctors                  | 50          |             |                  |             |                  | Extrapolate from FY12 to FY13 (probably an overestimate)   |              |
| Dollars?                           | \$1,840,041 | \$289,110   | \$88,173         | \$605,466   | \$659,429        | \$3,482,219  |              |
| value of a single day              | \$740       | \$1,085     | \$980            | \$1,223     | \$1,185          |  |              |



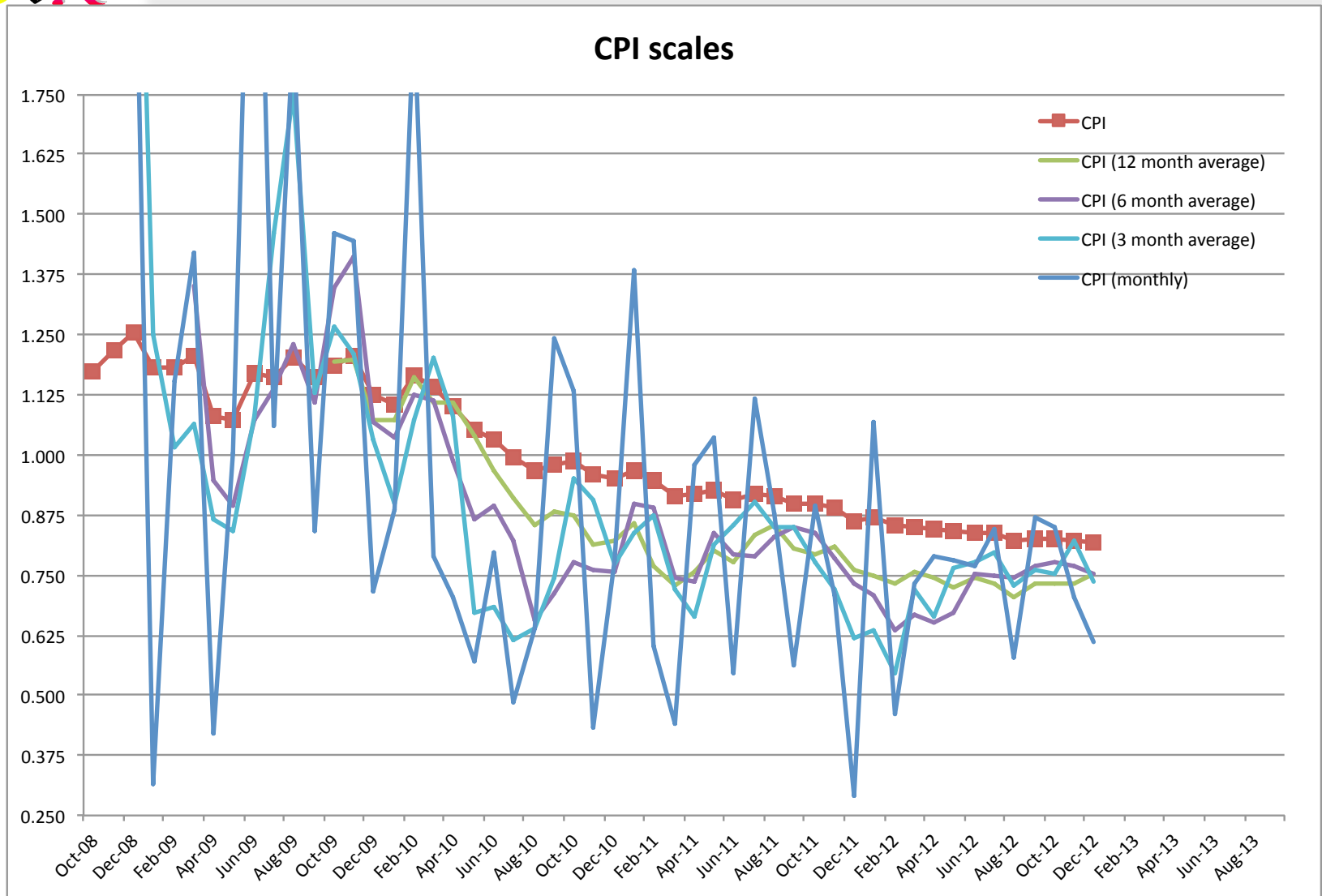
# EVMS Performance



| Month  | BCWS         | BCWP         | ACWP         | SPI   | SV (\$)   | CPI   | CV (\$)     |
|--------|--------------|--------------|--------------|-------|-----------|-------|-------------|
| Oct-11 | \$452,944    | \$616,798    | \$716,328    | 1.36  | 347,719   | 0.86  | (118,116)   |
| Nov-11 | \$732,319    | \$834,344    | \$1,178,574  | 1.14  | 102,025   | 0.71  | (344,231)   |
| Dec-11 | \$1,017,305  | \$369,795    | \$1,274,208  | 0.36  | (647,510) | 0.29  | (904,412)   |
| Jan 12 | \$581,113    | \$860,305    | \$805,092    | 1.48  | 279,192   | 1.069 | 56,587      |
| Feb-12 | \$561,330    | \$544,809    | \$1,180,131  | 0.97  | (16,521)  | 0.46  | (635,322)   |
| Mar-12 | \$759,409    | \$1,128,324  | \$1,541,540  | 1.49  | 368,914   | 0.73  | (413,216)   |
| Apr-12 | \$845,830    | \$820,307    | \$1,041,863  | 0.97  | (25,523)  | 0.79  | (221,555)   |
| May-12 | \$1,561,287  | \$1,372,793  | \$1,757,983  | 0.88  | (188,494) | 0.78  | (385,190)   |
| Jun-12 | \$1,785,348  | \$2,327,656  | \$3,027,918  | 1.30  | 542,308   | 0.77  | (700,263)   |
| Jul-12 | \$1,624,540  | \$1,762,817  | \$2,084,021  | 1.09  | 138,277   | 0.85  | (321,203)   |
| Aug-12 | \$1,534,787  | \$1,361,180  | \$2,360,712  | 0.89  | (173,607) | 0.58  | (999,532)   |
| Sep-12 | \$2,426,730  | \$2,035,864  | \$2,341,862  | 0.84  | (390,866) | 0.87  | (305,998)   |
| FY12   | \$14,097,119 | \$14,433,033 | \$19,725,484 | 1.02  | 335,914   | 0.73  | (5,292,451) |
| Oct-12 | \$1,353,600  | \$1,320,683  | \$1,552,026  | 0.98  | (32,917)  | 0.85  | (231,343)   |
| Nov-12 | \$834,116    | \$996,748    | \$1,412,398  | 1.195 | 162,632   | 0.71  | (415,650)   |
| Dec-12 | \$1,127,000  | \$689,000    | \$1,127,111  | 0.611 | (438,000) | 0.611 | (438,111)   |



# Shorter term trending?





# Task Breakdown

| Values             |                   |                     |                        |
|--------------------|-------------------|---------------------|------------------------|
| Row Labels         | Count of PMT Type | Sum of Total Money  | Sum of Remaining Money |
| In Progress        | 134               | \$8,360,421         | \$1,830,681            |
| A                  | 2                 | \$211,895           | \$158,921              |
| C                  | 80                | \$7,207,393         | \$1,362,178            |
| E                  | 28                | \$685,531           | \$243,680              |
| F                  | 24                | \$255,602           | \$65,902               |
| (blank)            |                   | \$0                 | \$0                    |
| Planned            | 69                | \$2,302,376         | \$2,160,715            |
| A                  | 4                 | \$0                 | \$0                    |
| C                  | 19                | \$1,025,712         | \$902,669              |
| E                  | 9                 | \$542,808           | \$542,808              |
| F                  | 37                | \$733,856           | \$715,238              |
| (blank)            |                   | \$0                 | \$0                    |
| <b>Grand Total</b> | <b>203</b>        | <b>\$10,662,797</b> | <b>\$3,991,396</b>     |

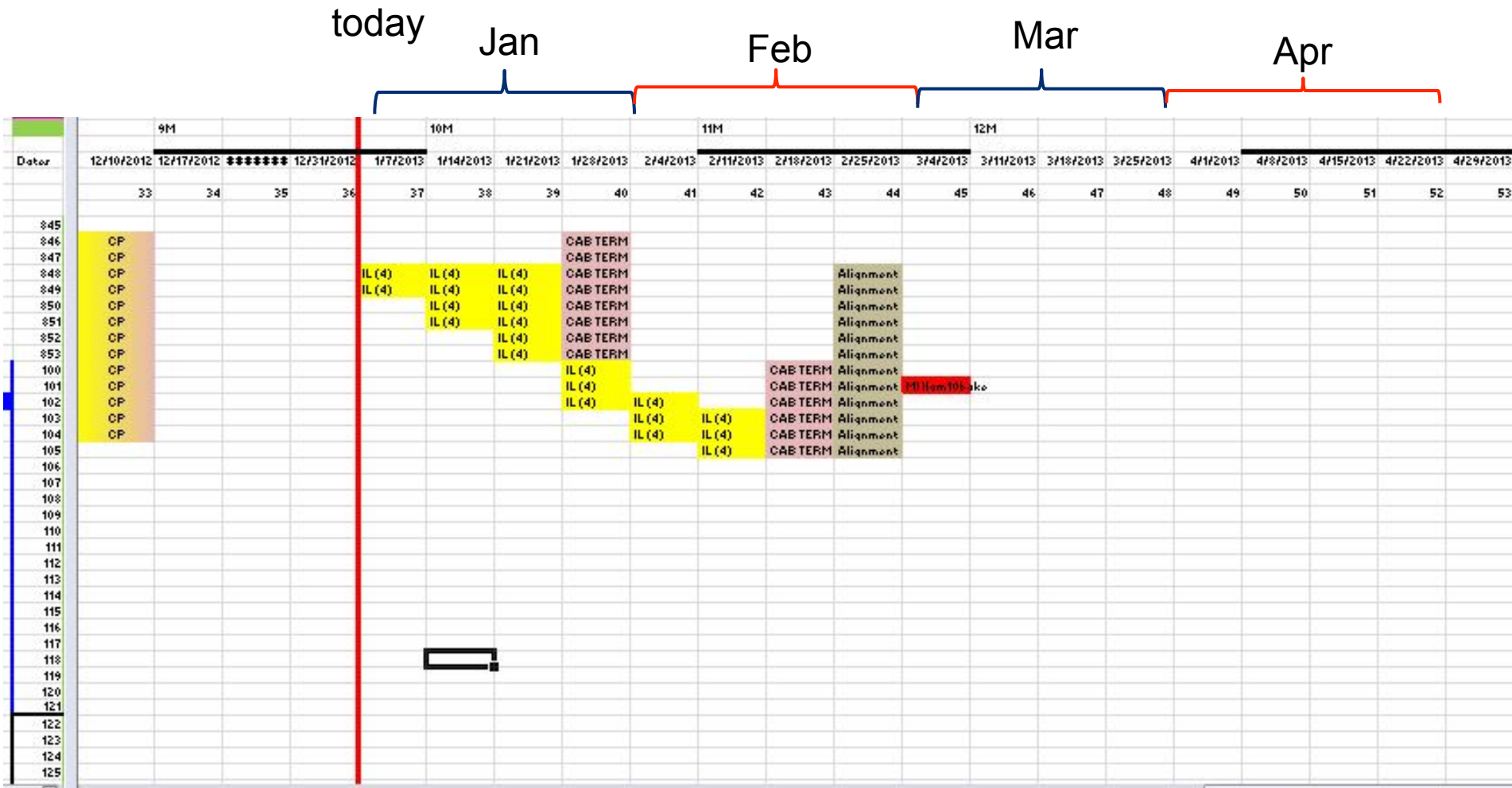
A: Level of effort  
 C: % Complete (can have peg points)  
 E: 50-50  
 F: 0-100

Remaining Money is budget\*(1-% complete), not BCWR

\$231K in those two types (\$189k in type F)



# Injection line Schedule











# NuMI Target Hall schedule

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- We will complete a Hi-Pot test of the walkway stripline on Tuesday January 22nd.
- The stripline protective fence will be installed January 23nd through February 1st.
- We will be installing the Horn 2 stripline jumper the week of January 28th.
- We will be replacing the Horn 1 stripline block the week of February 4th.
- The scheduled installation date for Horn 1 is February 11th through February 22nd.
- We plan to complete three days of Horn 1 & 2 Pulse Testing including thermal imaging of the stripline at the new rep rate the week of February 25th.
- Complete power supply testing the week of February 25th.
- The scheduled installation date for the Target is April 1st through April 12th.
  
- We will ready for low intensity beam to complete beam scans on April 26th.
  
- This is a partial schedule which addresses installation and testing of the primary components. If you have questions please call.